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Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our Editorial Policies and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed
☐	☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒ The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒ A description of all covariates tested
☐	☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒ For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐ Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	No software was used for data collection.
Data analysis	We used JMP Pro 16 for statistical analyses.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

The data are available under restricted access from the Rush Alzheimer's Disease Center (RADC) following the data and resource sharing policy. Access of data can be obtained by submitting requests through the RADC platform https://www.radc.rush.edu/requests.htm.

Human research participants

Policy information about studies involving human research participants and Sex and Gender in Research.

Reporting on sex and gender	n=936 participants were included in analyses of incident AD. Among them, 721 (77%) were female. n=320 participants were included in the analyses of AD pathologies. Among them, 223 (70%) were female.
Population characteristics	n=936 participants were included in analyses of incident Alzheimer's dementia (AD). Their mean age was 81.36 (7.16) years. Among them, 721 (77%) were female. n=320 participants were included in the analyses of AD pathologies. Their average age at death was 90.14 (6.19). Among them, 223 (70%) were female.
Recruitment	We analyzed data from the Rush Memory and Aging Project (MAP), which is a clinical-pathologic cohort study launched in 1997. Participants were recruited from retirement communities, senior and subsidized housing, and via church groups in northeastern Illinois (USA) and were followed annually. In 2005, wrist actigraphy (Actical, Phillips Respironics; Bend, OR, USA) was incorporated into the study protocol as an annual assessment. The analytic baseline for the current study was defined as the initial actigraphy assessment. The data utilized in this study, including wrist actigraphy, dementia diagnosis, and AD pathologies, were gathered up until December 2022, marking the cutoff point for our dataset.
Ethics oversight	The Rush MAP was approved by an institutional review board of the Rush University Medical Center. All participants signed informed consent, a repository consent for data sharing, and Anatomical Gift Act for organ donation. The current secondary data analysis was exempted by the Institutional Review Board of the Mass General Brigham.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	A total of 1,401 participants with actigraphy data in the Rush Memory and Aging Project were included in the analyses. Among them, 936 participants were included in analyses of incident AD, and 320 participants were included in the analyses of AD pathologies. The sample size was determined base on the available participants in this database that met inclusion and exclusion criteria.
Data exclusions	A total of 1,401 participants completed baseline actigraphy assessment. For the analyses on AD incidents, we excluded n=84 with AD at baseline, n=115 without follow-up clinical/cognitive assessment, and n=266 with too short or too long nap duration. Thus, we included n=926 in the analyses on AD incidents and longitudinal cognitive changes. For the analyses on AD pathologies, we used data from n=704 died and donated their brains for autopsy and excluded n=257 that died more than 3 years after their last actigraphy assessment and n=127 with too short or too long nap duration. Thus, we included n=320 in the analyses of AD pathologies.
Replication	This is a population-based cohort study, and we have not yet replicated the findings in other datasets. In order to ensure the reproducibility of the study, various statistical analyses were performed: 1) Cox proportional hazards models were performed to test the associations of baseline nap characteristics with incident Alzheimer's dementia, adjusting for a wide range of covariates. 2) Linear regression models were performed to regress the AD pathologies against napping characteristics from the last actigraphy assessment (i.e., proximate to death). We interpreted our findings based on the findings from the above analyses.
Randomization	N/A as it is an observational study.
Blinding	N/A as it is an observational study.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging